GAS-PRODUCTION SCENARIOS FROM HYDRATE ACCUMULATIONS AT THE MALLIK SITE, McKENZIE DELTA, CANADA

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RESEARCH OBJECTIVES

The Mallik site represents an onshore permafrost-associated methane hydrate accumulation at the McKenzie Delta, Northwest Territories, Canada. A 1,150 m deep gas hydrate research well was drilled at the site in 1998 and led to the first significant body of field data from a natural-gas hydrate deposit (Dallimore, et al., 1999). An international consortium of seven organizations from five countries is currently planning a new test well for the analysis of dissociation under field conditions. The objective of the Berkeley Lab component of this research is the analysis and evaluation of various gas production scenarios from several hydrate deposits.

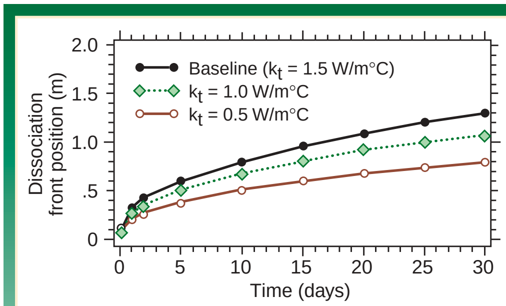

Figure 1. Sensitivity of dissociation front to the thermal conductivity

APPROACH

The analysis of several production scenarios currently under consideration was conducted using the TOUGH2 general-purpose simulator (Pruess, 1991) for multicomponent, multiphase fluid and heat flow and transport in the subsurface with the EOSHYDR2 module (Moridis et al., 1998). EOSHYDR2 is designed to model the nonisothermal CH_4 release, phase behavior, and flow under conditions typical of CH_4-hydrate deposits (i.e., in the permafrost and in deep-ocean sediments) by solving the coupled equations of mass and heat balance. The model accounts for up to four phases (gas phase, liquid phase, ice phase and CH_4-hydrate phase) and up to seven components (CH_4-hydrate, water, native methane, dissociated methane, salt, water-soluble inhibitors, and heat). The model can describe hydrate dissociation involving any combination of the possible dissociation mechanisms (i.e., depressurization, thermal stimulation, salting-out effects, and inhibitor-induced effects).

ACCOMPLISHMENTS AND SIGNIFICANCE

Early investigations indicated that production from accumulations with free gas and/or water zones underlying the hydrate deposit was not promising because of adverse conditions at the site. The study focused on accumulations with no underlying free gas or water zones, and a CH_4-hydrate saturation of at least 50% (the remainder being pore water). Thermal stimulation by circulating hot water in the well was selected as the main method of dissociation because of its effectiveness and simplicity under the conditions of the planned field test. These are significant factors in the effort to analyze field parameters of hydrate dissociation performance.

Sensitivity studies indicated that CH_4 release from the hydrate accumulations at the Mallik site increases with the CH_4-hydrate saturation, the hydrate initial temperature, the temperature of the circulating water in the well, the well boundary conditions, and the thermal conductivity of the system (Figure 1). CH_4 production appears to be less sensitive to the rock and hydrate specific heats, the permeability of the formation in the range observed at the site, and the irreducible gas saturation. A general observation of the study is that the extent of the dissociation zone appears to be limited within the short operational window of the planned test (necessitated by adverse climatic conditions at the arctic site).

REFERENCES

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ACKNOWLEDGMENTS

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